

PATENT SPECIFICATION

(11) 1278639

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DRAWINGS ATTACHED

- (21) Application No. 60659/69 (22) Filed 12 Dec. 1969
- (23) Complete Specification filed 3 Dec. 1970
- (45) Complete Specification published 21 June 1972
- (51) International Classification H01S 3/22
- (52) Index at acceptance

H1C 202 206 207 208 20X 20Y 24Y 25Y 26Y 341 343
34Y 366 36Y 370 392 39Y 471 521 523 52Y
530 702 724 73Y 798

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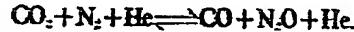
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(71) We, FERRANTI LIMITED, a company registered under the Laws of Great Britain, of Hollinwood in the County of Lancaster, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

THIS INVENTION relates to gas lasers, and particularly to such lasers of the high-power carbon-dioxide type.

Certain high power gas lasers use as the active medium a mixture of carbon dioxide, nitrogen, and helium. It has been found that the performance of such a laser falls off if the gas mixture is allowed to remain in the tube, and for this reason it is usual to replenish the gas mixture, continuously passing the mixture into the laser tube and venting it to the atmosphere. The disadvantage with this technique is that helium is an expensive material, and in the larger lasers a considerable quantity of helium is required.

It is believed that the fall-off in the performance of the laser is due, at least in part, to a change in the chemical composition of the gas mixture. The most probable reaction is represented by the following reversible equation, though other products containing one or more of the elements carbon, nitrogen or oxygen may be formed.



The carbon dioxide and nitrogen are changed, at least in part, by the effects of the electric discharge used to excite the laser, and form carbon monoxide and nitrous oxide. The helium is not affected chemically.

It is an object of the invention to provide a gas laser in which the rate of replenishment of the gas mixture is substantially reduced.

According to the present invention there is provided a gas laser comprising a discharge tube containing a gas mixture, which includes

a closed-circuit gas circulation system comprising a pump for extracting the gas mixture from the laser discharge tube, a reaction vessel through which the gas mixture is passed by the pump, means for maintaining the reaction vessel at a temperature at which some or all of the dissociation of the gas mixture occurring in the laser discharge tube is reversed, and a throttle valve operable to control the pressure at which the gas mixture re-enters the laser discharge tube from the reaction vessel. 45

An embodiment of the invention will now be described with reference to the accompanying drawing. This shows, in schematic form, a laser tube and the associated gas circulation system. 50

Referring now to the drawing, the laser itself is shown in a simplified form as comprising a tube 10 having a pair of end mirrors 11 and 12, and being provided with two discharge electrodes 13 and 14. The remainder of the drawing shows the gas circulation system. Gas is extracted from the laser discharge tube by means of a pump 15, and is passed through an oil-mist filter 16A to remove any contamination due to the pump itself. After passing through the filter the gas mixture passes through an otherwise empty alumina tube 17 heated by a heating element 18, and thence through a silica-gel trap 16B to remove any water vapour or organic vapours. The gas mixture then returns through a throttle valve 19 to the laser discharge tube 10. The circuit between the throttle valve 19 and the pump 15 via the laser tube 10 is maintained at the low pressure required to operate the laser, whilst the remainder of the circuit is at a higher pressure, possibly above atmospheric pressure. 65

In order to allow for gas leakage from the system sources of the three gases are provided as shown at 20, 21, and 22, each being provided with a stop valve 23, 24 and 25 respectively. The gas mixture is bled into the high-pressure side of the circulation sys- 70 75 80 85 90

tem by means of a bleed valve 26. A pressure-
5 relief valve 27 is also provided in the high-
pressure side of the system, and communi-
cates with the atmosphere. The rate of usage
10 of the make-up gases from sources 20, 21
and 22 will be very small compared with
the quantities required when the circulating
gas mixture is exhausted direct to the atmos-
phere. It may be desirable to use flow-meters
15 at various points in the circulation system,
though these have not been shown in the
drawing. The gases may, of course, be pre-
mixed and drawn from a single cylinder.

In operation the heating element 18 is
15 arranged to maintain the alumina tube 17 at
a temperature of about 700°C. At this tem-
perature the re-combination reaction occurs
at the required rate. It may be necessary to
20 cool the gases before passing them back into
the laser discharge tube.

If the pump 15 is of a type which does not
25 cause contamination of the gasses passing
through it, then the oil-mist filter 16A may
be omitted.

25 The heater 18 may be located either in-
side or outside the reaction vessel 17.

WHAT WE CLAIM IS:—

1. A gas laser comprising a discharge tube
30 containing a gas mixture, which includes a
closed-circuit gas circulation system compris-
ing a pump for extracting the gas mixture
from the laser discharge tube, a reaction
35 vessel through which the gas mixture is
passed by the pump, means for maintaining
the reaction vessel at a temperature at which
some or all of the dissociation of the gas
mixture occurring in the laser discharge tube
40 is reversed, and a throttle valve operable to
control the pressure at which the gas mix-
ture re-enters the laser discharge tube from
the reaction vessel.

2. A gas laser as claimed in Claim 1 in
which the reaction vessel is an alumina tube
45 containing only the gas mixture.

3. A gas laser as claimed in either of
Claims 1 or 2 in which the reaction vessel
is maintained, in operation, at a temperature
of the order of 700°C.

4. A gas laser as claimed in any one of
the preceding claims in which the gas mixture
50 in that part of the circulation system which
includes the reaction vessel is maintained,
in operation, at a pressure greater than that
in the discharge tube.

5. A gas laser as claimed in any one of
the preceding claims in which a silica gel trap
55 is included in the gas circulation system be-
tween the reaction vessel and the throttle
valve.

6. A gas laser as claimed in any one
of Claims 1 to 5 which includes means for
replacing one or more of the constituents of
the gas mixture.

60 7. A gas laser substantially as herein de-
scribed with reference to the accompanying
drawing.

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Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1972.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from
which copies may be obtained.

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